

TITLE: Hermeticity Effects on GaAs and InP Devices (enough funding to close out task for FY00)

Responsible NASA Center: JPL

PROGRAM GROUP: Microelectronics Reliability

DESCRIPTION AND APPROACH:

GaAs and InP devices present a special challenge for application in low cost, high reliability space systems. One aspect of this challenge relates to the use of these materials and components in non-hermetic enclosures, where moisture is considered to cause device parameter shift, performance degradation, and a concern for long term reliability.

Limited data is made available regarding this issue from industry sources. The available data seems to present a contradiction, especially for InP devices. However, InP devices do exhibit performance degradation as a result of exposure to moisture.

In this task, we will collect reliability data from various device manufacturers and users for moisture effects on GaAs and InP devices. This data will be evaluated and tests will be conducted on devices, if necessary, to further assess moisture sensitivity. Test structures specifically for moisture sensitivity evaluation will be designed and fabricated, in collaboration with University of Michigan, on InP to assess the effects on a controlled sample representative of available processes. Upon completion of data collection and testing, guidelines and recommendations will be generated for application of these devices in non-hermetic enclosures.

The results of this task will benefit all GaAs and InP device users and manufacturers in understanding moisture effects on these devices and the long-term reliability implications. The results of this task will also provide recommendations for a suitable methodology for cost effective packaging of these devices for high reliability applications.

TASK OBJECTIVES:

The objectives of this task include the following:

1. Assess the reliability of GaAs and InP devices used in non-hermetic enclosures for space applications.
2. Review and evaluate data available from various industry partners on device performance, parameter shift, and reliability.
3. Design, fabricate, and evaluate test structures to assess moisture effects on InP devices
4. Conduct testing to verify available data when necessary.
5. Provide guidelines and recommendations for application of these devices in non-hermetic applications.

ALIGNMENT WITH EEE/AI PROGRAM OBJECTIVES

- I. The results of this task will provide test data and methodology to accelerate the insertion of GaAs and InP devices for use in high reliability applications.
- II. The results of this task will facilitate faster infusion of this technology in NASA applications and projects by identifying cost effective and reliable methods of application of these devices.

III. The results of this task will provide for a wider selection of devices and components for use in various communication systems and high frequency experiments with substantiated reliability data.

IV. All data, test reports, and publications will be disseminated to the NASA and industrial community via suitable technical publications, NASA technology reports, and made available on the NPPP homepage.

DELIVERABLES:

The results of this task will have the following deliverables:

1. Report of industry data summary.
2. Test structure designs and test data.
3. Test data and evaluation results of moisture effects on GaAs and InP devices.
4. Recommendations and application guidelines for use of GaAs and InP devices in non-hermetic applications.
5. Technical papers and publications

PARTNERSHIPS AND ENDORSEMENTS:

1. TriQuint Semiconductor, TRW, Hughes Space and Communications, Lockheed Martin Sanders.
2. EOS-MLS endorsement (Code Y & S)
3. Mars Exploration Program endorsement (Code S & M)
4. NASA-GRC collaboration on data collection and analysis (Code R)
5. Collaboration with University of Michigan on the design and fabrication of InP test structures.

SCHEDULE MILESTONES:

- 1Q99
 - Data Collection and Evaluation
- 2Q99
 - Fabricate InP test structures and set-up tests
- 3Q99
 - Perform tests on GaAs and InP devices
- 4Q99
 - Evaluate device test data and write intermediate report
- 1Q00
 - Recommendations and guidelines
- 2Q00
 - Final report and recommendations

PRINCIPAL INVESTIGATOR or CONTACT:

Point of Contact:

Rosa Leon

JPL

Tel. (818) 354-2195

FAX (818) 393-4559

Email: rleon@jpl.nasa.gov